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The following information was drawn from documents submitted by the applicant.

54 Method and device to improve training of athletes.

57 The invention relates to a method and device to determine sports medicine- and training-pertinent information such as current speed, average speed, distance covered, stopwatch, time, direction, geographic position, distance from the start, heart rate, EKG, body temperature, height above sea level, and calorie use for sports that can be done anywhere. These parameters are determined by identifying the geographic position data in relation to biological characteristic values. They are indicated to the wearer in real time, as well as stored and analyzed.

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Description

The invention generally relates to a method and a device to determine sports medicine-parameters, similar to those found on a bicycle tachometer, for athletes and recreational users. The invention is intended to provide persons engaged in competitive sports or recreational activities a maximum amount of information regarding their sports activities. This ability is based on combining biological data such as body temperature, heart rate, and EKG with information such as time, covered distance, current speed, average speed, and height above sea level to calculate energy used and training condition, and to indicate this information to the person in an up-to-date manner and to store it.

Prior art only makes these possible to date by means of expensive systems and only for specially prepared training courses. Athletes located away from such training courses now only have access to very simple and incomplete devices to analyze their performance. These include pulse measurement devices for example, whose values do not take into account covered distance, time and speed and thus, do not provide any clear information and must be read as a watch. Systems such as pace counters are also very inaccurate and do not provide indication or analysis functions either. There are currently no systems for conventional sports, adventure sports, or recreational activities, such as trekking, windsurfing, horseback riding, jogging, rafting and inline skating that provide such simple functions as displayed by a bicycle tachometer for example. The trend is currently moving towards more new sports activities that are not conventionally done in a gyms or stadiums, but out in open terrain, on water or in the mountains. In addition to values that are significant for sports medicine-related diagnoses, the athletes themselves are interested in better understanding their training and monitoring their activities.

Given the method and devices mentioned in the introduction, the task of this invention is therefore to correct the stated shortcomings and to provide athletes of any sports and participants in any recreational activities with a small, autonomous hand-held device with which they can obtain various types of information about their training. In accordance with this invention, this task is solved by using individual-related and biological measurements in relation to geographic information such as used in the application of satellite positioning systems like the Global Positioning System (GPS). Combining and correlating various data produces a multi-purpose training and recreational device. The unit comprises the following components: an active or passive GPS antenna, an HF amplifier, an analysis unit for time lapse differences of the satellite signals to determine geographic position, expansion by a differential GPS module for any desired position information, an infrared pulse sensor, EKG electrodes, an acceleration sensor, a temperature sensor, the centralized electronics system, and the system carrier such as a cap, bicycle helmet or protective headwear.

The following drawings further illustrate the invention.

Fig. 1 depicts the mounting and arrangement of the components on a cap.

Fig. 2 depicts the value-display on a display on the cap's brim.

Fig. 3 depicts the value-display with a reflecting mirror.

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Fig. 4 depicts measurement of the pulse at the ear.

Fig. 5 depicts the block diagram for the device.

Fig. 6 depicts measurement of the body temperature.

In Fig. 1, one can see GPS antenna 2 mounted on the upper edge of cap 14 for good reception. Electronics system 1 is located on the flat portion of the cap brim. Transparent LCD display 3 to depict the information is located on the cap edge within the visual field of the eyes. Infrared sensor 7, preferentially a thermopile, has its opening oriented towards the face and records the body temperature. Rechargeable battery pack 4 is located on the backside of the cap to distribute weight more evenly. Infrared sensor 5 to measure the pulse is located above the ear. EKG electrodes 6 are fastened to the upper body by means of a chest strap and connected to the cap and electronics system by means of a cable. Acceleration sensor 13 is mounted to or in electronics system 1. Reset button 14 and mode button 15 allow diverse configurations of the device, such as zeroing the stopwatch and distance meter, and switching on the display illumination.

In Fig. 2, one can see the position of LCD display 3. The display is transparent so as not to limit the field of view. It can also be made visible in darkness by means of background illumination.

In Fig. 3, one can see another variant of the display indicator. Display 3 can be integrated into electronics system 1 so that the values are made visible by reflecting mirror 15 on the brim edge. In this case, the values on the display must be depicted back to front.

Fig. 4 depicts the position of pulse meter 5. The edge of the cap is slightly extended at ear-height and infrared transmitter 8 and infrared receiver 9 are mounted across from each other at the ear. The advantage is that nothing is clamped on, thereby resulting in no mechanical pressure on the ear.

Fig. 5 depicts the device's block diagram. Signals from GPS antenna 2, EKG electrodes 6, pulse sensor 5, acceleration sensor 13, and DGPS 12 (for increased accuracy) are processed by microprocessors in electronics unit 1 and displayed on display 3. The received data can be stored in memory storage 10 and later retrieved by linking the electronics system with a three-pole cable to be then output on a PC. Acceleration sensor 13 allows measuring the individual's pace frequency. Installing radio transmitter or GSM (Global System for Mobile communications) module 15 allows data to be transferred online to a receiving station via radio.

Fig. 6 depicts measurement of body temperature by means of a contactless infrared surface temperature meter. Thermopile 7 is installed in electronics system 1 and can view the face through an opening in the cap brim.

The device acquires data such as geographic position and satellite time from the GPS information and using that data combined with time, the device can provide additional information such as the stopwatch function by means of reset button 14, height above sea level, compass indications during movement by calculating the motion vector, current speed by combining time with the distance, average speed by computing average value, and distance covered by adding up the individual distances. When combined with bio-medical values such as pulse rate, EKG and body temperature, complete charting of the data can be shown online to athletes

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or it can be analyzed later on a PC by selecting data. The following information can be depicted on the display:

- Time: contained in the satellite signal.
- Speed: computed from the two readings separated by time difference dt = t1 - t2 and the distance between the two position coordinates latitude$_1$ / longitude$_1$ and latitude$_2$ / longitude$_2$.
- Direction: when moving, the vector direction between two position coordinates, latitude$_1$ / longitude$_1$ and latitude$_2$ / longitude$_2$.
- Distance covered: adding up of individual distances between the position coordinates.
- Distance from the start: calculation of the distance between the position coordinates at the start where the distance meter and time were zeroed and the current position coordinates.
- Pulse: calculated from 60 seconds divided by the time measurement between two pulses measured at the ear or measurement of time between two R-spikes of the EKG signal.
- EKG: recorded over time.
- Body temperature: measurement of the thermopile's output voltage and that on a temperature probe attached to the thermopile such as an NTG for example, and compensation and correction using the temperature probe.
- Altimeter: calculated from the GPS values.
- Pace counter: measured from the impulses of the acceleration sensor.
- Stopwatch: obtained from zeroing the GPS data, whereby the current time at the start is stored and the stopwatch = current time.
- Start time.
- Calories burned: exact indication of the calories burned using information about the height, speed, distance, time, pulse, and body temperature. This computation is based on the athlete's body weight and known medical computation principles.

By installing a radio transmitter in the electronics module, the data can also be sent via radio signal to a receiving unit online. By integrating a GSM module, one can call the athlete and download the stored data. In an emergency or in the event of injury, the athlete or the device can send data and position coordinates autonomously to a rescue center if critical values have been exceeded. Instead of the LCD display with alphanumeric depiction, one can also use a graphics-capable mini-monitor, upon which positions and way path are depicted on a scanned-in map. Also, prior to training, a terrain map is scanned in using a PC or copied by a route-planning program, and then transferred serially into the electronic module's data memory using a plug connector. Besides attaching EKG electrodes to the athlete, one can also attach them to an animal with which the athlete is training. While riding, the horse's EKG signal can be used to obtain the animal's pulse rate, thus enabling rider and horse to be monitored.

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Claims

1. Method to determine key, sports medicine-related and sports-specific parameters, **characterized in that,** by receiving global, geographic position data with a receiving antenna 2 and its analysis in an electronics unit 1 and when combined with the measurement of biological parameters such as pulse using an infrared sensor 5, a contactless infrared temperature sensor to measure body temperature 7, an acceleration sensor 13 to record pace frequency and movement determination, and an EKG measuring system consisting of electrodes 6 and their analysis in the electronics unit of animals, preferentially humans, information regarding training status as well as currently essential information such as current speed, distance, and height above sea level, information regarding the training state as well as up-to-date key information such as current speed, distance and height above sea level measured independent of location can be measured and exact assertions can be made about performance potential and energy usage.
2. Method according to Claim 1 characterized in that these parameters can also be acquired without fixed training courses and additional aids or markings, and solely by means of this method.
3. Method according to Claim 1 characterized in that biological data such as body temperature, pulse, and EKG are recorded and displayed in real time to the athlete.
4. Method according to Claim 1 characterized in that the EKG electrodes are affixed to the athlete's body and the signals are analyzed in the electronics unit 1.
5. Method according to Claim 4 characterized in that the EKG is also used to determine the athlete's pulse.
6. Method according to Claim 1 characterized in that the sensors of EKG electrodes 6, the infrared pulse meter 5 and the acceleration sensor 13 are not mounted on humans but on an animal that trains or moves together with the athlete, but whose readings are displayed to the athlete.
7. Method according to Claim 1, characterized in that the entire device is mounted on an animal.
8. Method according to Claim 1, characterized in that a differential GPS system is integrated into the electronics unit to improve the accuracy of the GPS system.
9. Method according to Claim 1, characterized in that a thermopile is used to measure body temperature 7.
10. Method according to Claim 1, characterized in that all data gathered during training is stored and later output by a PC.
11. Method according to Claim 1, characterized in that all of the GPS system's direct geographic data is displayed to the athlete.
12. Method according to Claim 1, characterized in that additional information derived from the geographic position data are calculated in combination with time, such as current speed, direction, and height above sea level for example.
13. Method according to Claim 1, characterized in that

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distance covered, distance from the starting point and stopwatch functions are available thanks to temporary data storage.
14. Measurement and display device for athletes characterized in that the GPS antenna 2, the electronics unit 1 with integrated acceleration sensor 13, the display 3, the temperature probe for contactless temperature measurement 7, the rechargeable battery or conventional battery pack 4 and the infrared pulse meter 5 are attached to a cap 14, and the electrodes for the EKG 6 are connected to 1 by means of a cable or transponder principle.
15. Device according to Claim 14 characterized in that a battery or a solar cell is used as a power source instead of a rechargeable battery.
16. Device according to Claim 14, characterized in that a helmet or protective headwear is used instead of the cap 14.
17. Device according to Claim 14, characterized in that the helmet, cap, or protective headwear can be fastened with a chinstrap.
18. Device according to Claim 14, characterized in that a plug is located on the electronics unit, which can be connected to a PC for bi-directional transfer of stored data and programming.
19. Device according to Claim 18, characterized in that the connection operates wirelessly using a transponder or infrared.
20. Device according to Claim [sic], characterized in that the infrared pulse meter 5 is comprised of two individual IR transmitters 8 and 9, and are mounted on the cap in such a manner that when the cap is properly seated on the head, the ear is located between 8 and 9.
21. Device according to Claim [sic], characterized in that the EKG electrodes 6 are affixed to the athlete's body preferentially in the chest area using an elastic band and are attached to the electronics unit 1 by means of a cable or transponder.
22. Device according to Claim 14, characterized in that the system's components are not attached to a cap but to a wrist, belt, or training apparatus.
23. Device according to Claim 22, characterized in that the training apparatus is a surfboard, kayak, sailboat, horse, or other known mount.
24. Device according to Claim 14, characterized in that the display 3 is mounted on the cap's brim in the individual's field of view.
25. Device according to Claim 14, characterized in that instead of the display 3, a mirror 15 is mounted on the brim and the display is housed with back-to-front depiction in the electronics unit 1 in such a manner that the individual's field of view falls on to the display thanks to the reflecting mirror.
26. Device according to Claim 14, characterized in that the display 3 is a mini-monitor with which graphic images such as maps can be depicted.
27. Device according to Claim 14, characterized in that glasses with an integrated display are used as a display.
28. Device according to Claim 14, characterized in that the body temperature reading sensor 7 is seated on the cap brim and

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measures the face's surface temperature.
29. Device according to Claim 14, characterized in that the sensor 7 is located next to the pulse meter 5 by the ear for contactless temperature measurement.

Four (4) pages of drawings are attached hereto.

Drawing page 1

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Fig. 1

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Fig. 2

Fig. 3

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Fig. 4

Fig. 5

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Fig. 6